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O. P. BRYSCH, Editor

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1. GAS INDUSTRY

Future Fuel for Steel

Brook, W. H. THE FUEL AND ENERGY REQUIREMENTS OF THE STEEL INDUSTRY. *J. Inst. Fuel* (British), **29**, 465-71 (1956) November.

Based upon continuation of the use of equipment essentially similar to that now installed, the Australian steel industry will require, for some years to come, an equivalent fuel consumption of 1.5 to 1.75 tons of 13,500 Btu coal per ton of marketable steel. Coking coal requirements represent 1.25 tons of this with the remainder, supplied by byproduct fuels, fuel oil and boiler coal, going to open-hearth, rolling and works power. The inevitable expansion of the industry will require an expansion in the fuel demand. Detailed analyses of fuel practice at the coke ovens, open hearths, rolling mills and power plants shows the careful attention given to integrated fuel efficiency, and also the trend to imported fuel oil, and possible increases in use of electricity. O. P. Brysch

Gas and Energy, 1975

Bureau of Statistics, A.G.A. GAS AND TOTAL ENERGY DEMANDS IN 1975. *Amer. Gas Assoc. Monthly*, **39**, 16-18, 45-46, 48 (1957) January.

Estimates by the U. S. Bureau of Mines and others show that the yearly energy demand in the U.S.A. by 1975 may be between 68,000 to 75,000 trillion Btu compared to the current demand of approximately 40,000 trillion. From a projection of previous trends in the ratio of gas usage to other competitive fuels, it is estimated that by 1975, gas will supply 60% of the competitive fuel demand, or approximately 21,250 trillion Btu. This would require 22.5 trillion cu ft of natural gas production after correcting for unavoidable processing and transmission losses, and would represent over twice the current production rate. Other estimates place the 1975 production requirement in the range 15 to 23.8 trillion cu ft. To achieve a potential production of above 20 trillion cu ft/year by 1975 will require a significant upward revision of ultimate reserves, say in the range 850 to 1,000 trillion cu ft. Proven reserves are 224 trillion cu ft. A significant contribution to natural gas reserves is anticipated to exist in the Continental Shelf. Even if the more optimistic estimates of ultimate gas reserves are correct, the gas supply is not anticipated to be adequate to meet the projected production rates for much more than 5 to 10 years after 1975. Production of supplementary gas would be warranted to extend the life of natural gas resources and to control costs and supply problems on a regional basis. C. G. von Fredersdorff

Industry Regulation

Oates, J. F., Jr. NATURAL GAS IN FIELDS OF COMPETITION AND REGULATION. *Indep. Petroleum Assoc. Monthly*, **27**, 31, 32, 34. 40, 50, 51 (1956) November.

A speech given at the Independent Petroleum Association's Annual Meeting at Dallas on October 29-30, 1956 is reported. The author points out the economic considerations which call for co-operation among distributor, pipeliner, and producer. He suggests that amendment of the Natural Gas Act to exclude producers from regulation is one of the major problems of the industry. As a solution to this problem he suggests a list of goals for the FPC and for Congress in amending the Act. R. W. Walters

Information Searching

Perry, J. W. and Kent, A. THE NEW LOOK IN LIBRARY SCIENCE. *Appl. Mech. Rev.*, **9**, 457-60 (1956) November.

Failure to apply recorded knowledge in planning, conducting, evaluating, and exploiting research can result in restricted returns from the money budgeted. Of the 3 basic information operations—storage, identification of pertinence, and retrieval from storage—that of identification has received intensive study recently. This has been in the direction of establishing definitions or codes of characteristic concepts into which the stored items of information can be analyzed. Since the information requested is usually a combination or multiplicity of these concepts, the requested group of concepts must be determined, and this group matched against the coded record of stored concepts. A "true" or "close" match indicates that a particular stored item is pertinent. This matching (searching), by modern mechanical or electronic mechanisms, permits retrieval

over a larger collection of items in a shorter time. Industry-wide collections, processed centrally, appear to be the most economical approach. O. P. Brysch

Nuclear Research

A-SEARCH FACILITIES A-PLENTY. *Chem. Eng. News*, **34**, 5934, 5936 (1956) December 3.

The Shell Development Co. Research Center, Emeryville, Calif., is installing a 3 m.e.v. linear accelerator, the most powerful radiation source in industry, to study the interaction of high energy electrons on liquid and solid phase molecules. Argonne National Laboratory has placed in operation a revolutionary-type nuclear reactor, designated ZPR-V or zero power: "slow-fast" reactor, which has all the advantages of a fast reactor for breeding purposes but none of the disadvantages since the nuclear process is controlled by the slow reactor. A new atomic facility under construction at General Electric, San Jose, Calif., will be used to study procedures for refueling large boiling water reactors, specifically for the 180,000 kw Dresden plant of Commonwealth Edison, near Chicago. Heavy water moderated reactors for electric power generation will be studied by du Pont for AEC. The use of natural uranium as fuel will be emphasized. C. G. von Fredersdorff

2. APPLIANCES, DOMESTIC

Air Conditioning

Taubeneck, G. F. FORGET ABOUT THE FUTURE . . . START BUILDING NOW! Nagler. K. B. HERE IS WHAT YOU HAVE TO SELL NOW! *Gas Age*, 118, 23-30 (1956) December 13.

These articles are reports that reveal why there is a tremendous market for gas air conditioning and why immediate action by the gas industry is necessary because of the present interest shown by electrical manufacturers. Included in the second is a short descriptive summary by six manufacturers: Servel, Carrier, Ready-Power, Coleman, A. O. Smith, and Rheem, of their air-conditioning equipment and basic systems. A. M. Pelczarski

Simmons, L. L. (assignor to American Blower Corp.). AIR CONDITIONING APPARATUS. U. S. 2,773,678 (1956) December 11.

Wyckoff, P. W. (assignor to Chrysler Corp.). AIR CONDITIONER. U. S. 2,773,675 (1956) December 11.

Burners

Mayhew, R. L. (assigned to Hydrocarbon Research, Inc.) APPARATUS FOR COMBUSTION OF HYDROCARBONS. U. S. 2,772,729 (1956) December 4.

Schwank, G., Treuhand, A. G. and Franken, W. (assigned to American Infra Red Radiant Co.). RADIATION BURNERS. U. S. 2,775,294 (1956) December 25.

Van der Lee, A. (assigned to Hartford National Bank and Trust Co.). SELF GASIFYING PETROLEUM GAS BURNER. U. S. 2,775,292 (1956) December 25.

Warnecke, R. I. (assigned to Roberts Gordon Appliance Corp.). GAS BURNER AND CONSTANT PILOT. U. S. 2,772,730 (1956) December 4.

Cooking Ranges

Jacobson, R. A. HEAT APPLICATION TO COMMERCIAL RANGE HEAVY-DUTY TOP SECTIONS. PART III: CENTER FIRED HOT TOP RANGES. Amer. Gas. Assoc. Lab. Project IA-5 (1956) October.

An A.G.A. publication covering the 3rd phase of work done under project IA-5, "A study of various methods of heat application to commercial range heavy-duty top sections." The performance data obtained from an experimental burner designed for twice the normal burner input rates, retaining approximately the same minimum turndown rates, indicated that the heating time could be reduced to one-half. No decrease in thermal efficiency was noted. Further increases of input rate resulted in only slight additional savings of heating time.
A. E. Richter

Customer Load

Segeler, C. G. FOOTNOTE FOR LOAD CHARACTERISTICS. *Gas Age*, **118**, 23-6 (1956) December 27.

An effort is made to put customer load characteristics for various parts of the country on a common basis so that each load study made would be more widely useful. In one case this

is accomplished by relating house heating customer demand per MBtu to equipment capacity to temperature. (See also *Gas Abs.* **13**, 1 (1957)). R. T. Ellington

Household Incinerators

Vandaveer, F. E. THE DOMESTIC GAS-FIRED INCINERATOR'S ROLE IN AIR POLLUTION CONTROL. *J. Air Pollution Control*, **6**, 90-97 (1956) August.

Included in this report are the findings and development of the smokeless, odorless, and fly ash free domestic gas fired incinerators, as determined by A.G.A. research. Also shown are calculations determining air pollution in direct relationship to domestic gas fired incinerators during operation. Another interesting point was the detailed explanation of two-stage incineration, and the methods used for improvement of operation during each stage. Test data and illustrations are used to simplify some of the explanations. A. M. Pelczarski

Vandaveer, F. E. TOMORROW'S INCINERATORS TODAY. *Amer. Gas. Assoc. Monthly*, **38**, 18-20, 25, 34 (1956) October.

What has been done to develop new incinerators? Why was this development necessary? What is the present status of development and manufacture of new smokeless, odorless, fly ash-free domestic gas-fired incinerators? A discussion on methods used to gain answers to these three questions, along with many other interesting explanations concerning domestic gas-fired incinerators is comprised in this article. A. M. Pelczarski

Winegardner, D. CHANGING LIVING PATTERN MEANS MORE SALES FOR INCINERATORS. *Gas Age*, **118**, 38-39, 60 (1956) December 13.

The ever-increasing problem of disposing of 10 million tons of waste paper per year in the United States is discussed, together with the enormous potential for the sale of household gas incinerators. Promotion is geared to stress the advisability of including an incinerator as a necessary complement to an electric disposer in home building and modernizing. The importance of gas incinerators is emphasized as municipal money savers, controllers of vermin, and preventers of home fires. A. E. Richter

Space Heating

Lowe, F. J., Jr. WHAT ABOUT COMBUSTION CHAMBERS? *Gas Heat*, **7**, 25-27 (1956) December.

Here is a detailed explanation on the construction of combustion chambers. Included are the applications used and the method of applying the one best suited for your particular use. Throughout the article advice is given on problems that sometimes arise and their possible solutions. A. M. Pelczarski

Weather and Send-Out

Smith, C. P. REDUCING THE ODDS IN WEATHER BETTING. *Oil Gas J.*, **54**, 174-99 (1956) November 19.

This article is a considerable discussion of the problem of predicting gas sendout from past system performance and weather behavior. The notion of direction of departure from normal temperature, and its correlation between spring and winter is of particular interest.

R. F. Bukacek

3. COMBUSTION AND INDUSTRIAL FURNACES

Combustion Research

Anagnostou, E., Brokaw, R. S., and Butler, J. N. EFFECT OF CONCENTRATION ON IGNITION DELAYS FOR VARIOUS FUEL-OXYGEN-NITROGEN MIXTURES AT ELEVATED TEMPERATURES. *Nat, Adv. Comm. for Aeron. Techn.* Note 3887 (1956) December.

Ignition delays for mixtures of ethane, *n*-butane, isobutane, hydrogen, or propane with oxygen and nitrogen were measured using a flow system with two experimental procedures. Delays were measured in the temperature ranges 571° to 733°C for ethane, 444° to 715°C for *n*-butane, 564° to 713°C for isobutane, 594° to 652°C for hydrogen, and 540° to 681°C for propane. The effect of fuel concentration was measured for all fuels, and delays were inversely proportional to fuel concentration to the 0.6 to 1.7 power. The effect of oxygen concentration was measured for propane and the butanes, and, in general, delays decreased slightly with increasing oxygen concentration. However, at very low temperatures, for *n*-butane, the dependence on oxygen concentration increased. The two procedures gave different ab-

solute values for the delays, but the trends were the same by either method. From the variation of delay with temperature at constant fuel and oxygen concentration, apparent activation energies were calculated. Author's Abstract

Gilbert, M. G., and Prigg, J. A. THE PREDICTION OF THE COMBUSTION CHARACTERISTICS OF TOWN GAS. *Gas J.* (British), **288**, 654-56, 661-63, 666-69 (1956) December 12.

A method of predicting the combustion characteristics of a gas from its analysis is presented. The method is based upon the methods of Delbourg in France and of Weaver in America, and has been developed and modified for use under British conditions. A number of gases that are used or have been proposed for use in the town gas supply have been examined by the method, and samples of some of these gases have been made up in the laboratory and their characteristics determined. Agreement between the predicted characteristics and those found is reasonably good. The method involves the use of a calculated flame speed and, therefore, cannot be considered as completely satisfactory; check testing of existing appliances thus remains necessary. Nevertheless, the types of unsatisfactory performance that are liable to occur with a particular gas are indicated and the testing of appliances on samples of the new gas can be reduced to a minimum.
Author's Abstract

Convection

Jackson, E. G., and Kilham, J. K. HEAT TRANSFER FROM COMBUSTION PRODUCTS BY FORCED CONVECTION. *Ind. Eng. Chem.*, **48**, 2077-79 (1956) November.

New constants are determined for McAdam's convection equation, which give better representation of the data. R. T. Ellington

Industrial Ovens

Feiner, B., and Kingsley, I. VENTILATION OF INDUSTRIAL OVENS. *Air Condg., Heatg. and Ventilg.*, **53**, 81-89 (1956) December.

After a liquid coating is applied to some object, this coating must be dried or baked in an industrial oven. Proper ventilation and design of the ovens are important because of the solvents and vehicles used in order to avoid fires and explosions. This article presents what is considered good design and it also covers proper oven operation. Design data and problems are included. Author's Abstract

Municipal Incinerators

Greeley, S. A. CRITERIA FOR MUNICIPAL INCINERATORS: THE DESIGNER'S VIEW. *Mech. Eng.*, **78**, 1024-27 (1956) November.

The design of municipal incinerators involves a rather complex engineering study and must take into consideration many local and operating factors. Local conditions which must be given consideration are: the quantity and kind of refuse, surface and subsurface conditions at the site, adjacent roadways, climate, type of building suited to the locality, and the environment as affecting the chimney and its discharge. Operating design criteria extends to those items which affect the efficiency of operation, such as, combustion characteristics of the refuse, furnace operating methods, fly-ash collection and removal, control instruments and means for air pollution control. S. Close

Treating Atmospheres

Huebler, J. THE SAFE OPERATION OF ATMOSPHERE FURNACES. *Metal Progress*, **70**, 78-83 (1956) December; *Industrl. Heatg.*, **23**, 2567-80 (1956) December.

Basic safety measures needed to prevent explosions of the atmospheres used in some industrial furnaces. R. W. Walters

4. CARBONIZATION AND GASIFICATION

Coal & Ash Handling

Yeager, U. B. UNLOADING AND PLANT HANDLING OF COAL AND ASHES. *Coal-Heat*, **72**, 13-26 (1956) December.

Techniques and equipment are discussed for car unloading, belt feeders, magnetic separators, storage, conveyors and elevators, sampling, chutes, and weighing of coal, primarily in large-scale boiler or power plants. Ash handling is discussed from the standpoint of available conveying and firing systems, including mention of ash properties, separation and collection, and furnace techniques. Equipment manufacturers are listed for each type of operation and also summarized in a convenient tabulation. O. P. Brysch

Coal Sulfur

Blaydon, H. E., Mott, R. A. THE DESULPHURISATION OF COAL AND COKE. *Gas World* (British), **144**, 961 (1956) November.

In the United Kingdom the depletion of the Welsh coals with low sulfur content has necessitated the use of high-sulfur coals in the manufacture of blast-furnace coke, and this has resulted in the production of coke with high-sulfur content which is detrimental for the production of pig iron of low sulfur content. Elimination of excessive sulfur from pigiron can be accomplished only by improving the process of desulfurization of iron.

K. C. Channabasappa

Coal Gasification

Hartill, I. J. COMPLETE GASIFICATION. *Gas World* (British), **144**, 853-56 (1956) October 27; *Gas J.* (British), **288**, 441-44 (1956) November 14.

The development work and modifications conducted by the North West Gas Board in a 500 MCF per day two-stage coal water gas plant are discussed. This type of plant is based upon the Tully system consists of a retort superimposed upon a water gas generator with the coal being first carbonized in the retort and the coke produced being then gasified to water gas in the generator. A 1,000 MCF per day plant at Wallasey designed on the basis of experience and results obtained in the smaller plant is also described. Estimated costs for the production of a 462 Btu gas are tabulated.

E. J. Pyrcioch

Myhill, A. R. THE SIGNIFICANCE, INTERPRETATION AND RELIABILITY OF CARBONIZING TEST FIGURES. *Gas Times* (British), **89**, 134, 136, 140, 142 (1956) November 9.

The article discusses the defects in applying uniform corrections to the operating results obtained during carbonization of coals varying in rank and ash content in the same plant, and for the same coal in different plants, when producing make-gas of a pre-determined calorific value. Unrestricted comparison of these corrected results may lead to erroneous results.

K. C. Channabasappa

Townend, D. T. A. COAL SCIENCE AND THE GAS INDUSTRY. Inst. Gas Eng. Commun. No. 494 (1956) November 20; *Gas World* (British), **144**, 1068, 1087 (1956) November 24; 1188-91 (1956) December 8; *Gas J.* (British), **288**, 538-40, 544-46 (1956) November 28.

The Director-General of the BCURA reviews the status of coal science and its applications to the gas industry. Accumulated knowledge, experience and techniques relating to coals and their properties has led to improvements in selection of coals for a particular purpose from a standpoint of coal rank, petrological constituents and mineral components. Applications of this knowledge and of continued fundamental research will improve the control of the products, the efficiency and the economics in the fields of carbonization, gasification and combustion.

O. P. Brysch

Foreign Gas

THE STORY OF GAS IN CEYLON. *Gas World* (British), **144**, 1014-16 (1956) November 17; *Gas Times* (British), **89**, 207, 9, 11 (1956) November 23.

The first gas works in Colombo, Ceylon, began supplying gas in August, 1872. Carbonization of coal in horizontal retorts was the original method and is still practiced in redesigned and rebuilt retorts. Coal from India is used exclusively. Operation of the plant is almost entirely manual with very little mechanization. Aside from coke which is sold for domestic and industrial use, tar is the only by-product which is recovered and marketed. Approximately 237 MMCF of 400 Btu gas is produced annually.

E. J. Pyrcioch

Graham, J. I. PROBLEMS OF FUEL PRODUCTION AND UTILIZATION IN NEW ZEALAND. *J. Inst. Fuel* (British), **29**, 504-15 (1956) November.

A brief review of energy resources of New Zealand are presented and a comparison is made of the energy production from coal, hydroelectricity and imported oil. Details of mining, production and probable reserves of coal are given. Certain properties peculiar to high-rank bituminous coals of this region are mentioned. The status of gas and coke industries is reviewed and the necessity for more efficient utilization of the fuels in New Zealand is

stressed. The necessity for a better coördination in research work between the members of the New Zealand Institute of Fuel is emphasized. K. C. Channabasappa

Gasification Costs

Ongstad, O. C., Chetrick, M. H., and Oppelt, W. H. COST DATA FOR GASIFICATION OF LIGNITE IN AN EXTERNALLY HEATED RETORT. Rep. Invest. 5272, U. S. Bur. Mines (1956) November.

This report presents cost data for an externally-heated annular retort gasifier experimental unit for gasifying lignite together with an estimate of major equipment costs and operating costs for a plant producing 50 MMCF of (H_2+CO) per day. Major plant equipment includes 10 retort gasifiers, 2 gas producers, a synthesis gas scrubbing system, and lignite, residue and ash handling equipment. Gas producers fueled with lignite residue from the retorts supply gas for heating the retorts. Process steam for the producers is generated in the water jacket of the producer. The raw synthesis gas is scrubbed to remove traces of tar and dust, but no further purification is done. Capital cost for a 50 MMCF of (H_2+CO) per day plant using natural lignite is estimated at $24,257,200, while a plant of the same capacity using steam-dried lignite (12-15 percent moisture) is estimated to cost $19,396,400. Operating cost for gasifying natural lignite is estimated to be 37.6 cents per MCF of (H_2+CO) and for gasifying steam-dried lignite in a plant of the same capacity it is estimated to be 32.0 cents per MCF of (H_2+CO). Design details of the externally-heated retort gasifier are presented. E. J. Pyrcioch

Hydrogasification

Dent, F. C., Edge, R. F., Hebden, D., Wood, F. C., and Yarwood, T. A. EXPERIMENTS ON THE HYDROGENATION OF OILS TO GASEOUS HYDROCARBONS. Gas Council Research Commun. GC37 (1956) November; *Gas J.* (British), **288**, 600-04, 606, 607, 610 (1956) December 5; *Gas World* (British), **144**, 1078, 1080 (1956) November 24.

Petroleum oils were hydrogenated in a fluidized bed of coke particles at 700° to 900°C. and up to 50 atmospheres. Almost complete conversion of light distillates to 863 Btu/SCF gas was achieved; yields from gas oil and crude oil were about 79 to 82 percent gas, most of the remainder being a light aromatic condensate. Two applications were explored: (1) the production of about 400 Btu/SCF gas for enrichment of gas obtained by Lurgi gasification of coal; (2) the production of high-Btu gas in a process using oil as the sole raw material. Additional laboratory tests of oil cracking in hydrogen using empty reactor tubes are reported. Details of the pilot plant construction are given. E. B. Schultz, Jr.

Lignite Technology

Gomez, M., Goodman, J. B., and Parry, V. F. EFFECT OF OXIDATION ON CARBONIZATION YIELDS OF A TEXAS LIGNITE. U. S. Bur. Mines Rep. Invest. 5277 (1956) November.

The effects of oxidation on carbonization yields were studied by oxidizing a Texas lignite in air at temperatures up to 300°C. for varying lengths of time followed by carbonization at 500°C. in a laboratory assay unit. The results indicate that increased oxidation caused a decrease in the tar yield and an increase in gas yield in a ratio of 1:1. It is surmised that, on oxidation and carbonization, tar-yielding structures principally yield gaseous products and some char. Char-yielding structures in the fresh coal give rise to additional water of decomposition after oxidation and pyrolysis. Some oxidation of coal particles, measured as a decrease in the tar plus light-oil yield, is observed when lignite is dried and carbonized under conditions where transport and carbonizing gases include tar. K. C. Channabasappa

Parry, V. P. (assigned to U. S. of America). CONTINUOUS PROCESS FOR DRYING, PREHEATING AND DEVOLATILIZATION OF CARBONACEOUS MATERIALS. U. S. 2,773,018 (1956) December 4.

A process is claimed for drying, preheating and devolatilizing carbonaceous materials (lignites) which comprises passing the particles (¾ inch to 0) into an upward stream of hot gases (300°F.) entraining them therein, drying and preheating, and separating the solids from the gas and moisture. The solids are again entrained in air and passed upwardly through a reaction zone at 850° to 1000°F., to form char, tar and gases. An intermediate storage zone between the drying and the reaction zone is claimed. O. P. Brysch

McMurtrie, R., and Oppelt, W. H. DEVELOPMENTS IN LIGNITE TECHNOLOGY AND UTILIZATION. *Ind. Eng. Chem.*, **48**, 1996-2000 (1956) November.

The author discusses the several possibilities of utilizing the extensively available low-rank lignites of Dakota and Montana. Details on the extent of reserves and methods of mining are given. Experimental data obtained at the U. S. Bureau of Mines laboratories on low-temperature carbonization and gasification of these lignites are summarized. K. C. Channabasappa

Mexican Coke Ovens

Fitz, W. DIE KOKEREI MONCLOVA IN MEXIKO (AHE MONCLOVA, MEXICO, COKING PLANT). *Gas- und Wasserfach* (German), **97**, 888-92 (1956) November 1.

An important step in the industrialization of Mexico has been realized by the construction of the new coke-oven plant for the Altos Hornos de Mexico, S. A., in Monclova, Coahuila, Mexico, where its operation began on January 20, 1955. The plant consists of 114 ovens in 2 batteries of H. Koppers cross-flow combination type, of 2200 tons daily dry coal capacity, with complete coal and coke handling, and coal-chemical recovery plant. The coal is supplied by 3 mines of the Sabinas basin. The coke over 40-mm size is sent directly to the 2 blast furnaces. The gas is used for under-firing, with the surplus going to a boilerhouse, but with future plans for its use in the steel furnaces. Ammonium sulfate is produced, with sulfuric acid from the H_2S recovery plant. Tar is distilled to yield light, middle and heavy fractions.

O. P. Brysch

Naphthalene Removal

Faingold, S. G., and Shevchenko, A. J. KONECHNOYE OKLAZHDENIYE GAZA S ISVLECHENIYEM NAPHTALINA IZ VODY SMOLOYI (FINAL COOLING OF GAS WITH EXTRACTION OF NAPHTHALENE FROM LIQUORS WITH TAR). *Koks i Khimiya* (*Coke and Chemistry*) (Russian), 32-36, (No. 7) (1956).

The naphthalene-laden water from the usual final cooler operation is contacted with blended primary and secondary tar. This treatment, in a continuous-flow contact-plate section at the base of the conventional cooler, removes most of the naphthalene (and phenols) from the water, which can be recycled after gravity settling of the separated phases. Flow sheets and data from two plants are presented. O. P. Brysch

Oil Gasification

Fauser, G. (assigned to Montecatini, soc. gen. per Industria Mineraria a Chimica). PROCESS FOR THE PRODUCTION OF HYDROGEN AND CARBON MONOXIDE FROM LIQUID FUELS (HEAVY MINERAL OILS). U. S. 2,772,955 (1956) December 4.

A process for the production of a synthesis gas consisting substantially of carbon monoxide and hydrogen, said process comprising preheating heavy mineral oil to a temperature of the order of 100° to 150°C., intimately admixing therewith a catalytic amount of a chemical selected from the group consisting of calcium nitrate and magnesium nitrate, atomizing said admixture into an atmosphere of steam and oxygen preheated to a temperature of at least 300°C. and not more than 600° to 700°C., permitting the reaction to take place and adjusting the proportions between said heavy mineral oil, steam and oxygen to maintain a reaction temperature between 1100° and 1200°C.

Selected Extracts

Gerhold, M. DIE VERFAHRENSTECHNISCHE ENTWICKLUNG DER OELSPALTVERFAHREN ZUR ERZEUGUNG VON STADTGAS UND INDUSTRIEGASEN. (TECHNICAL PROCESS DEVELOPMENT OF OIL CRACKING PROCEDURES FOR THE PRODUCTION OF CITY AND INDUSTRIAL GASES). *Erdoel und Kohle* (German), **9**, 765-70 (1956) November.

A review is given of the cracking and rearranging possibilities of hydrocarbons. An outline of the procedures for the production of ethylene- and olefin-rich gases is presented with schematic flow sheets. G. Kunst

Precipitator

Silverman, L., and Dennis, R., ELECTROSTATIC PRECIPITATOR. *Air Condg., Heatg., and Ventilg.*, **52**, 75-80 (1956) December.

Results of extensive tests to determine the collection efficiency of a portable electrostatic filter for various airborne contaminants. Tests were made at two air flow rates.

Authors' Abstract

5. NATURAL GAS AND NATURAL GAS CONDENSATES

Automation

Donnelly, R. W. ARE PIPELINERS READY FOR AUTOMATION? *Pipe Line Ind.*, **5**, 57-50 (1956) November.

This article expresses the point of view that much remains to be done in training personnel for automation. Several aspects of the training problem are discussed and a course outline for training in pineline automation is offered. A list of institutions offering information about supervisory training courses is also given.

R. F. Bukacek

Jones, F. S. IN AUTOMATION ENGINEER'S DUTIES ARE THREEFOLD. *Pipe Line Ind.*, **5**, 56-57 (1956) November

The threefold duties expounded by this article are: to keep the management informed on economics and administration, to cooperate with operations in design and maintenance, and to insure that this system is well engineered.

R. F. Bukacek

Compression

Hipple, M. L. DESIGN CONSIDERATIONS FOR SMALL UNATTENDED FIELD GAS COMPRESSORS. *Petroleum Eng.*, **28**, B110, 112, 116, 118, 120 (1956) November.

This article considers the various factors involved in selecting unattended field gas compressors. A table showing preliminary information required for design and specification of compressor stations is given. The author concludes that each application of field compressors must be decided on its own merits in view of the design alterations available.

R. F. Bukacek

Van Gundy, C. UTILIZATION OF PIPELINES AND COMPRESSING STATIONS AT MAXIMUM EFFICIENCY. Amer. Gas Assoc. Operg. Sect. GSTS-56-7 (1956) May 10-11.

This article, a presentation to the American Gas Association Gas Supply, Transmission and Storage Conference of May 10, 1956, considers various problems in dispatching the complex pipeline system of Panhandle Eastern Pipe Line Company.

R. F. Bukacek

Drilling

Cunningham, R. A. (assigned to Hughes Tool Co.). ROLLER CUTTER FOR EARTH DRILLS. U. S. 2,774,570 (1956) December 18.

Miller, G. (assigned to Oil Base, Inc.). DRILLING FLUID COMPOSITION AND METHOD. U. S. 2,773,670 (1956) December 11.

Morlan, E. A. (assigned to Hughes Tool Co.). CONE TYPE WELL DRILL. U. S. 2,774,573 (1956) December 18.

Norman, J., Jr., and Hamil, A. B. APPARATUS FOR PLACING SEISMIC EXPLOSIVE CHARGES. U. S. 2,773,669 (1956) December 11.

H_2S Removal

Taylor, D. K. HOW TO DESULFURIZE NATURAL GAS. *Oil Gas J.*, **54**, 125 (1956) November 5.

Removal of H_2S with iron oxide is discussed.

D. M. Mason

Logging Equipment

Bennett, A. D., and Silverman, D. (assigned to Stanolind Oil and Gas Co.). FLUID ENTRY DETECTION IN WELLS. U. S. 2,775,120 (1956) December 25.

Bennett, A. D., and Silverman, D. (assigned to Stanolind Oil and Gas Co.). FLUID INPUT AND DIAMETER MEASUREMENT IN WELLS. U. S. 2,775,121 (1956) December 25.

Blake, F. G. (assigned to California Research Corp.). METHOD OF INDICATING UNDERWATER SEISMIC DISTURBANCES. U. S. 2,771,961 (1956) November 27.

Smith, N. J. (assigned to California Research Corp.). INTERVAL VELOCITY SEISMIC LOGGING. U. S. 2,771,960 (1956) November 27.

Pipeline Design

Rahleder, G. V. CUT CALCULATING TIME WITH COMPUTERS. Thomas, H. E. COMPUTER AIDS IN GAS PIPE LINE DESIGN. *Pipe Line Ind.*, **5**, 39-46 (1956) November.

These articles are concerned with the application of high speed computers to design calculations of pipeline companies. The first gives basic information about computer operation

with an illustration based on the experience of the Okan Pipeline Co. The second reports El Paso Natural Gas Pipeline Company's experience over a 12-month period with an electronic data processing machine. R. F. Bukacek

DOUBLE-JOINTING YARD KEY OPERATION. *Canadian Gas J.*, **49**, 20-21 (1956) October.

A brief, well-illustrated summary of the operation of the double-jointing yard installed to handle 40-foot sections of 34-inch pipe for the Trans-Canada pipeline. G. G. Wilson

TOUGHER STEELS IN MILL FOR FUTURE PIPE LINES. *Pipe Line Ind.*, **5**, 24-29 (1956) December.

A discussion of recent developments in the manufacture and testing of pipe. Topics discussed were the importance of field-testing pipe, methods of improving the toughness of steel, the development and use of high yield-strength steel for pipe, the results of welding tests on this type of pipe, the results of tests on the weldability characteristics of grade x—52 line pipe, and new developments in the manufacture and testing of double-submerged, arc-welded line pipe. G. G. Wilson

Pipeline Operations

Hale, D. AMERICAN LOUISIANA — NEWEST MEMBER OF AMERICAN NATURAL GAS FAMILY. *Petroleum Eng.*, **28**, D19-21 (1956) November.

A thumbnail sketch of the American Louisiana Pipe Line Company which includes brief descriptions of its affiliated companies, biographical sketches of its officers and top operating personnel, and a map showing the location of its facilities. G. G. Wilson

AMERICAN LOUISIANA — SURVEYS TO SERVICE IN RAPID TIME. *Petroleum Eng.*, **28**, D22-30 (1956) November.

A summary of the design and construction procedures, the materials and equipment, and the organization of the operating department of the American-Louisiana Pipeline Co. Interesting features of this line include operators on all mainline valves, a three-circuit communication network consisting of two telephone circuits and a radio circuit, and the use of polyethylene tape coating on 122 miles of the line. G. G. Wilson

MICHIGAN-WISCONSIN — NEW GULF COAST GAS SUPPLY TO RELIEVE PRESSING DEMAND. *Petroleum Eng.*, **28**, D-31-32 (1956) November.

The expansion program of the Michigan-Wisconsin Pipeline Co. is described and illustrated on a map of a portion of the system. A variety of operating statistics of the entire company are included. G. G. Wilson

Reservoir Flow

Cullender, M. H., Smith, R. V. PRACTICAL SOLUTION OF GAS-FLOW EQUATIONS FOR WELLS AND PIPELINES WITH LARGE TEMPERATURE GRADIENTS. *J. Petrol. Tech.*, **207**, 281-87 (1956) December.

Rigorous equations for calculating subsurface pressures in flowing and static gas wells, and pressures along horizontal pipelines are presented in this paper. These general equations, based on the mechanical energy balance, contain no assumptions regarding temperature and can be used with either straight-line or curved temperature gradients. The friction factors recommended in this report are based on an absolute roughness of 0.0006 in. Flow is always considered to be turbulent. Although these general flow equations are solved by numerical means, the methods are as convenient as many of those used today to calculate pressures in gas wells and pipelines. The authors believe that the use of these methods will result in more accurately calculated pressures in gas wells and pipelines and that the methods are more flexible than any in use at the present time. Also, the methods are easily adaptable to automatic computers. Author's Abstract

Matthews, C. S., and Lefkovits, H. C., GRAVITY DRAINAGE PERFORMANCE OF DEPLETION-TYPE RESERVOIRS IN THE STRIPPER STAGE. *J. Petrol Tech.*, **207**, 265-74 (1956) December.

The performance of depletion-type reservoirs at the stage in which the gas is at such low pressure that gravity is essentially the sole driving force has been investigated both theoretically and by use of scaled models. A simple

theory is developed which completely explains the scaled model experiments. It also agrees with some field data. When the range of production rates to be considered is less than 25, the theory predicts that the production rate decline curve for homogeneous reservoirs in which there is a free surface will be of the hyperbolic type with $n = 2$:

$$q/q_i = 1/(1 + \gamma t)^2$$

The theory gives a physical significance to the parameter γ. Author's Abstract

Owens, W. W. Parrish, D. R. Lamoreaux, W. E. AN EVALUATION OF A GAS DRIVE METHOD FOR DETERMINING RELATIVE PERMEABILITY RELATIONSHIPS. *J. Petrol. Tech.*, **207**, 275-80 (1956) December.

Several methods are now being used by the industry for determining the gas-oil flow characteristics of reservoir rock samples. Most of the laboratory experimental methods can be classified either as steady-state, unsteady-state, or Hassler-type tests. Although the validity of the results obtained by any specific method is not questioned, in general, the complexity of these methods leaves much to be desired. This investigation dealt primarily with the development of a simplified unsteady-state (gas drive) laboratory test method for measuring kg/ko relationships of small core samples. A procedure for selecting uniform and representative sandstone rock samples was developed since it was observed that the reliability of the test results was dependent upon having a sample which was uniform in porosity and permeability. The importance of factors known to influence the results of this type test, such as oil viscosity, gas expansion and pressure differential were evaluated. The method of calculating the test results was found to give valid data over a wide range of gas expansion. The limits of pressure differential and oil viscosity which would insure reliable results were defined. In comparison with other presently used testing methods, the gas drive method requires considerably less apparatus, is less time consuming, and is more readily adaptable to a routine type core test.

Author's Abstract

Welding

Carpenter, O. R., and Wylie, R. T. 16-8-2 CR-NI-MO FOR WELDING ELECTRODE. *Metal Progress*, **70**, 65-73 (1956) November.

Because of difficulties encountered with welded stainless steel equipment in high temperature service, a new type of welding rod has been developed for use on this type of equipment. This article summarizes the difficulties which had been encountered and presents the results of tests run on various weld metal compositions to determine which would be most suitable for use in welding stainless steel for high-temperature service. The tests run were a soundness test, stress-rupture tests, V-notch import tests of aged welds, and restraint tests. The most satisfactory material was found to be a 16-8-2 Cr-Ni-Mo stainless steel. G. G. Wilson

Hill, A. M., and Zilm, F. W. WHAT CAUSES UNDERBEAD CRACKS IN WELDS? *Oil Gas J.*, **54**, 108-12 (1956) December 17; Gas, **33**, 106-11 (1957) February.

This article describes a new maintenance welding procedures for use on pipelines where the pipe surface temperatures are below 50°F. Also reported are the testing results used to devise the new procedure. R. F. Bukacek

Well Practise

Abendroth, G. F., Ilfrey, W. T., and Tausch, G. H. (assigned to Esso Research and Eng. Co.). METHOD FOR CONTROLLING SAND IN WELLS. U. S. 2,775,303 (1956) December 25.

Bond, D. C., and Holbrook, O. C. (assigned to The Pure Oil Co.). FRACTURING OIL AND GAS PRODUCING FORMATIONS. U. S. 2,772,237 (1956) December 4.

Brokel, A., and Healey, N. (assigned to Shell Development Co.). METHOD OF TEMPORARILY CLOSING PORTION OF WELL AND COMPOSITION THEREFOR. U. S. 2,772,739 (1956) December 4.

Carter, H. E. PITLESS WELL ADAPTER AND COUPLING APPARATUS. U. S. 2,771,-955 (1956) November 27.

Jenks, L. H., and Stanclift, R. J., Jr. (assigned to Esso Research and Eng. Co.). TREATMENT OF PETROLEUM PRODUCTION WELLS. U. S. 2,771,954 (1956) November 27.

Johnson, G. D. (assigned to Joy Mfg. Co.). WELL HEAD CONTROL. U. S. 2,771,956 (1956) November 27.

Kaveler, H. H. (assigned to Phillips Petroleum Co.). HYDRAULIC CEMENTS HAVING AN EXTENDED THICKENING TIME, METHODS OF MAKING THE SAME, AND PROCESSES EMPLOYING THE SAME. U. S. 2,771,953 (1956) November 27.

Kirkpatrick, W. H. (assigned to Visco Products Co.). PROCESS AND DEVICE FOR INHIBITING CORROSION IN WELLS. U. S. 2,775,302 (1956) December 25.

Tausch, G. H. (assigned to Esso Research and Eng. Co.). METHOD FOR COMPLETION OF WELLS HAVING HIGH BOTTOM-HOLE PRESSURES. U. S. 2,772,738 (1956) December 4.

Well Tools

Bedingfield, S. P. OIL WELL TESTING TOOL Re Issue 24,236 (1956) November 6 (of original U. S. 2,736,383 (1956) February 28).

Edwards, J. E. (assigned to M. L. Mayfield). WELL PACKER. U. S. 2,772,740 (1956) December 4.

Evans, S. (assigned to Hughes Tool Co.). THREADED OIL WELL DRILL STEM CONNECTION WITH THE THREADS HAVING INCLUDED CREST ANGLE OF 90 DEGREES. U. S. 2,772,899 (1956) December 4.

Hamontre, H. C., Mueller, F. G., and Armstrong, F. E. INSTRUMENT TO MEASURE THE DIAMETER OF SUBSURFACE WELL BORES. U. S. 2,771,686 (1956) November 27.

Huber, T. A. (assigned to Esso Research and Eng. Co.). APPARATUS FOR SQUEEZE CEMENTING WELL PERFORATIONS. U. S. 2,769,498 (1956) November 6.

Hutto, M. C., Jr. BORE GAGE. U. S. 2,771,687 (1956) November 6.

Kinley, J. C. INTERNAL PIPE CALIPERING TOOLS. U. S. 2,771,685 (1956) November 27.

Lewis, F. F. (assigned to Gem Oil Tool Co.). JET WALL CLEANER. U. S. 2,771,141 (1956) November 20.

Leibensperger, C. I. PUMP ROD ASSEMBLY. U. S. 2,773,671 (1956) December 11.

Middleton, W. H., and Earl, C. W. RELEASABLE COUPLING FOR WELL TOOLS. U. S. 2,775,306 (1956) December 25.

Polson, P. COMBINATION PARAFFIN SCRAPER AND ROD GUIDE. U. S. 2,772,741 (1956) December 4.

Weber, J. H. RETRIEVING TOOL FITTING IN AND ENGAGING WASH PIPE. U. S. 2,771,957 (1956) November 27.

Zandmer, S. M. APPARATUS FOR PROVIDING DUCTS BETWEEN BOREHOLE WALL AND CASING. U. S. 2,775,304 (1956) December 25.

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

Desulfurization

Phillips, R. J. NEW PROCESS FOR REMOVING REFORMER FEED STOCK SULFUR. *Petrol, Refiner*, **35**, 202-04 (1956) November.

Using acid-treating plus electrostatic mixing and coagulation, this process effects almost complete removal of sulfur in reformer feed stocks. Investment and operating costs are far less than hydrodesulfurization.

Author's Abstract

Oil Transport

Stoessel, H. WASSERWIRTSCHAFTLICHE PROBLEME BEI TRANSPORT AND LAGERUNG VON MINERALOELEN. (WATER ECONOMY PROBLEMS OF OILS IN TRANSPORTATION AND STORAGE.) *Gas- und Wasserfach* (German), **97**, 1025-28 (1956) December 15.

Considerable attention is paid in Germany to the danger of contamination of water by oils. The problems arise for the most part from prewar airport oil storage since in the case of a fluctuation of ground-water level the water desolves the odorous substances of the oil which are noticed in a concentration of 1:1,000,000 parts by volume. Oil contamination in the surface waters can be noticed easily and a prompt warning can prevent the infiltration of oils into the water plant. But with the increase of airports the amount of contamination increases

from cleaning machinery with special solvents which form a stable emulsion with water and oil and are consequently not separated by the usual methods. Special methods are developed and improved. Devices for oil extraction for the protection of rivers and lakes have been developed and applied on all navigable vessels. New procedures for underground storage are planned to prevent any possiblities of contamination. G. Kunst

Reforming

THERMOFOR CATALYTIC REFORMING. *Petrol. Processing*, **11**,.73-75 (1956) December.

Data are given for Socony Mobil's Thermofor catalytic reforming process. Two commercial units, built in 1954, are now being operated by Magnolia Petroleum Company and General Petroleum Corporation. H. L. Feldkirchner

Shale Retort Operations

Ruark, J. R., Berry, K. L., and Guthrie, B. DESCRIPTION AND OPERATION OF THE N-T-U RETORT ON COLORADO OIL SHALE. U. S. Bur. Mines Rep. Invest. 5279 (1956) November.

This report presents descriptions of two 40-ton-capacity batch N-T-U retorts, and correlations of the effects of various variables, such as air rate, recycle gas rate and shale particle size and grade. Shortcomings of the batch method of shale processing are pointed out. Before the retorts were dismantled, 920 runs were made with a total of 37.547 tons of shale consumed, and 20,265 barrels of crude oil produced.

E. B. Shultz

7. ANALYTICAL METHODS AND TESTS

Clay Minerals

Noonan, J. F. HOW TO IDENTIFY CLAY MINERALS: AND WHY. *World Oil*, **143**, 186, 191, 192, 200 (1956) December.

Kaolinite, montmorillonite and illite are three types of clay minerals of interest in production from reservoir sandstones. Structure, identification and effect on production are important.

Author's Abstract

Coal Ash Minerals

Jackson, P. J. and Smith, A. C. A RAPID METHOD FOR DETERMINING POTASSIUM AND SODIUM IN COAL ASH AND RELATED MATERIALS. *J. Appl. Chem.* (British), **6**, 547-59 (1956) December.

In connection with the analysis of coal ashes and related silicate materials, an investigation has been made of the interference of aluminum, iron, calcium, magnesium, silicate and borate in the determination of sodium and potassium by the EEL flame photometer. The effects of all these constituents, with the exception of calcium, were negligible in the ranges of concentration likely to be met in this work. The interference of calcium in the determination of sodium was eliminated by adding aluminum, incorporated in the hydrofluoric-sulphuric acid mixture used to decompose the sample. A method is proposed by which sodium and potasisum in silicates may be determined in 1½ hours. Results by this method compare favorable with those obtained by the J. L. Smith procedure, and by the Lundegardh flame spectrographic technique. Authors' Abstract

Radmacher, W. and Mohrhauer, P. DIE ENTMINERALISIERUNG VON STEINKOHLEN FUER ANALYTISCHE ZWECKE. (THE DEMINERALIZING OF BITUMINOUS COAL FOR ANALYTICAL PURPOSES.) *Brennstoff-Chemie* (German), **37**, 353-58 (1956) November 14.

A simple technique for analysis of bituminous coals is described. The mineral matter content is determined by treating the coals with acids. The moisture content needed in computing the volatile matter fraction is determined by selectively dissolving the silicate minerals. The proximate analysis obtained by this method agrees fairly closely with those obtained by the usual analytical procedure.

K. C. Channabasappa

Selvig, W. A. and Gibson, F. H. ANALYSIS OF ASH FROM UNITED STATES COALS. U. S. Bur. Mines Bull. 567 (1956).

This bulletin presents the analyses made by the Bureau of Mines on ash together with fusion temperatures of coals from known sources. These are summarized by State for ready reference. The occurrence of mineral matter in coal and the relation of ash composition to its fusibility are discussed briefly. Only the common

mineral constituents as determined in routine coal-ash analysis are given.

K. C. Channabasappa

Copper Corrosion Test

Mallatt, R. C., Demkovich, P. A., and Cropper, W. V. THE ASTM COPPER-STRIP CORROSION STANDARDS. *Amer. Soc. Test. Matl. Bull.*, No. 218, 49-51 (1956) December.

These visual standards are prescribed for use in evaluating copper strips that have undergone the ASTM D-130 procedure for detection of sulfur corrosiveness in petroleum products.

Authors' Abstract

Dissolved Oxygen

HOW TO DETERMINE DISSOLVED OXYGEN. *Petrol. Processing*, 11, 100-101 (1956) November.

Oxygen in liquid hydrocarbons is determined by stripping with inert gas and absorption of the oxygen in pyrogallol. D. M. Mason

Gas Chromatography

GAS CHROMATOGRAPHY. *Oil Gas J.*, **54**, 126-27 (1956) December 17.

Developments in chromatography, the role of column packing materials and carrier gases, sample introduction, detectors, and recorders, and establishing operating conditions and techniques are discussed. D. M. Mason

Industrial Wastes

Moore, W. A., and Ettinger, M. B., RECENT TRENDS IN THE ANALYSIS OF INDUSTRIAL WASTES. *Anal. Chem.*, 28, 1819-21 (1956) December.

Surface waters are becoming progressively scarcer, and their use for disposing of liquid industrial waste should be continually reexamined. Intelligent control of waste discharge must be based on analytical methodology, which does not appear to be keeping pace with the problem that confronts it. Requirements for discharge of wastes to surface waters will become increasingly critical.

Authors' Abstract

Ni-Co Method

Whealy, E. D. and Colgate, S. O. SPECTROPROTOMETRIC METHOD FOR SIMULTANEOUS DETERMINATION OF NICKEL AND COBALT. *Anal. Chem.*, **28**, 1897-98, (1956) December.

Aqueous solutions of nickelous and cobaltous nitrates react completely with diethylenetriamine to form solutions of colored complexes. Light absorption properties of complexes permit the quantitative determination of both nickel and cobalt in the absence of interfering cations. Authors' Abstract

8. GENERAL AND PHYSICAL CHEMISTRY

Catalysts

Sowerwine, E. O., Jr., (assigned to Wigton-Abbott Corp.) PROCESS FOR CONVERTING NICKEL SULFIDE TO NICKEL SULFATE. U. S. 2,772,947 (1956) December 4.

Regarded in certain of its broader aspects, the invention comprises heating spent nickel catalyst, primarily in the form of nickel sulfide, in an atmosphere of sulfur dioxide containing a limited amount of oxygen, and so controlling the oxygen and sulfur dioxide concentration. temperature, and pressure that the nickel sulfide is converted almost quantitatively to nickel sulfate and/or nickel sulfite. Selected Extracts

Haldeman, R. G. and Emmett, P. H. A STUDY OF THE WATER CONTENT OF A SILICA-ALUMINA CATALYST AND ITS COMPONENT OXIDES. *J. Amer. Chem. Soc.*, **78**, 2917-22, (1956) December.

The water content of silica-alumina cracking catalyst, of silica gel and of activated alumina has been measured over the temperature range 100 to 500° as a function of the prior exposure to water vapor, and for the silica-alumina catalyst as a function of the presence or absence of base-exchanged potassium or barium ions. The residual water content after evacuation for several hours at 500° was 0.79, 0.64 and 0.73%, respectively, for silica-alumina catalyst and for samples base exchanged with 0.58 milliequivalent of Ba++ per gram. Water retained by exposing samples to a few mm. of water vapor at 110° for an hour at this same temperature was found to be 0.2% by weight for silica-alumina catalysts, 0.6% for activated alumina and 0.0% for silica gel. The results are interpreted as indicating that most of the active sites on silica-

alumina catalysts are, after an evacuation at 500°, in the form of Lewis acids rather than Bronsted acids. Authors' Abstract

Haldeman, R. G. and Emmett, P. H. EXCHANGE OF HYDROGEN BETWEEN ISOBUTANE AND A DEUTERATED CRACKING CATALYST. *J. Amer. Chem. Soc.*, **78**, 2922-28, (1956) December.

The exchange of the hydrogen of isobutane with the deuterium of various deuterated materials has been studied at 150° as a function of their D_2O contents; these materials include silica-alumina, silica gel, alumina and silica-alumina base-exchanged with potassium and barium ions. For silica alumina evacuated at 500° prior to a test run, the exchange rate at 150° was found to be very small. The exchange rate increased with increasing water content of the solid, going through a maximum at a value which depended upon the prior history of the sample. Water contents greater than this optimum amount caused a decrease in the exchange rate. In general, the total amount of deuterium transferred to the isobutane during a run was found to depend upon primaryily on the temperature of final exacuation of catalyst, regardless of prior history or absolute amount of water in the catalyst. The base-exchanged catalyst and the component oxides were comparatively inert for hydrogen exchange. Apparently, water molecules must be added to or be available at some type of silica-alumina Lewis acid site before isobutane will undergo "activated adsorption" on the catalyst surface. Authors' Abstract

Gas Absorption

Vivian, J. E. and Peaceman, D. W. LIQUID-SIDE RESISTANCE IN GAS ABSORPTION. *Amer. Inst. Chem. Eng. J.*, **2**, 437-43, (1956) December.

The film theory of liquid-side resistance to gas absorption, embodying the assumption of a thin stagnant liquid film adjacent to the interface in which steady state diffusion occurs, has long been open to question, particularly in packed columns. Higbie's penetration theory, believed to be more reasonable, pictures the liquid as flowing over a piece of packing for a very short period of time before being mixed as it flows to the next piece of packing. In the penetration model absorption occurs during a series of brief contacts, and unsteady state mass transfer conditions prevail in the liquid. Several short glass wetted-wall columns 1.9 to 4.3 cm. long were constructed to simulate the assumptions of the penetration theory. Because of the short length, ripples were absent except when the gas rate was higher than ReG=2,200. The desorption of carbon dioxide from water and of chlorine from dilute hydrochloric acid (0.16 to 0.18 N) was studied. The desorption rate of carbon dioxide was unaffected by gas velocity up to ReG of 2,200 and increased 1.1%/°C. over the temperature range of 22° to 31°C. Authors' Abstract

Hexane

Weber, J. H. THERMODYNAMIC PROPERTIES OF n-HEXANE. *Amer. Inst. Chem. Eng. J.*, **2**, 514-17, (1956) December.

Thermodynamic properties of n-hexane have been calculated over a temperature range of 32° to 540°F. and up to a pressure of 600 lb./sq. in. abs. These properties were determined from vapor pressure, volumetric heat capacity, and latent heat of vaporization data through the application of rigorous thermodynamic relationships. The calculated data have been found to be internally consistent. The enthalpy values are believed to be accurate to within ±0.5 Btu/lb. and the entropy values at ±0.0005 Btu/(lb.) (°R.). Author's Abstract

Ionic Reactions

GAS PHASE IONIC REACTIONS. METHANE AND ETHYLENE. *J. Amer. Chem. Soc.*, **78**, 5697-5705 (1956) November 5.

Rate constants and reaction cross sections were measured for ionic reactions occurring in methane and ethylene in the ion source of a mass spectrometer. H. L. Feldkirchner

Lubrication Research

Bowden, F. P. and Menter, J. W. SYMPOSIUM ON LUBRICATION: THE FRICTION AND LUBRICATION OF SOLID SURFACES. *J. Inst. Petroleum* (British), **42**, 301-03 (1956) November.

The causes of frictional resistance between two sliding solid surfaces are summarized. The mechanisms which occur in overcoming the

frictional resistance of various substances under varying conditions are discussed. (See also Bowden, F. P., *Adhesion and Friction Endeavour* (British), **16**, 5-18 (1957) January.)

R. R. Amrine

Kurtz, S. S., Jr., King, R. W., Stout, W. J., Partikian, D. G. and Skrabek, E. A. RELATIONSHIP BETWEEN CARBON - TYPE COMPOSITION, VISCOSITY - GRAVITY CONSTANT, AND REFRACTIVITY INTERCEPT OF VISCOUS FRACTIONS OF PETROLEUM. *Anal. Chem.*, **28**, 1928-36 (1956) December.

A triangular graph has been developed which relates carbon-type composition in terms of per cent aromatic carbons, per cent naphthenic carbons, and percent parafinic carbons to viscosity-gravity constant and refractivity intercept for viscous petroleum fractions. If both viscosity-gravity constant and refractivity intercept are known carbon-type composition can be determined from this graph with reasonable accuracy. Viscosity, gravity, and refractive index are the only experimental data required for the use of this graph. It is useful in following the effect of solvent extraction, acid treating, hydrogenation of the viscous fractions of petroleum, and for comparing the composition of the viscous fractions from various crude oils.

Authors' Abstract

Smalbeer, C. V., and Mastin, T. W. LUBRICANT ADDITIVES AND THEIR ACTION. *J. Inst. Petroleum* (British), **42**, 337-47 (1956) November.

A discussion of what can be expected from bench testing and field testing of lube oil. Detergent additives are discussed with the emphasis on the basis of why one material is favored over some other material.

R. R. Amrine

Sulfur Monoxide

Meschi, D. J., and Myers, R. J. DISULFUR MONOXIDE. I. ITS IDENTIFICATION AS THE MAJOR CONSTITUENT IN SCHENK'S "SULFUR MONOXIDE." *J. Amer. Chem. Soc.*, **78**, 6220-23 (1956) December 20.

The product of an electric discharge through sulfur and SO_2 has been reported by several workers to be a mixture of SO and S_2O_2 in the gas phase. On the basis of mass spectrographic, stoichiometric and gas effusiometric measurements it is shown that this material is a mixture of SO_2 and disulfur monoxide, S_2O. The presence of any S_2O_2 in this product is highly improbable, though it is possible that a small amount of SO may be present in the mixture. The properties previously attributed to the presence of SO or S_2O_2 in the discharge product are shown to be due to S_2O.

Author's Abstract

9. ORGANIC CHEMISTRY

Acetylene

Stiles, S. R. (assigned to The M. W. Kellogg Co.) SEPARATION OF ETHYLENE FROM A GASEOUS MIXTURE. U. S. 2,769,321 (1956) November 6.

A method is described whereby ethylene may be removed from a mixture of low-boiling gases which involves low temperature fractional distillation under pressure. H. L. Feldkirchner

Isobutane Processes

Sherwood, P. W. PROCESSES FOR ISOBUTANE PRODUCTION, *Petroleum* (British), **19**, 393, 396, 410 (1956) November.

Methods for low-temperature catalytic conversion of n-butane to isobutane are discussed. Two vapor-phase and three liquid-phase processes are presented. H. L. Feldkirchner

Light Oil Recovery

Meinhold, T. F., and Thompson, C. V. BOOSTS COKE OVEN BY-PRODUCT RECOVERY 20%. *Chem. Processing*, **19**, 14-15, 20 (1956) December.

Increased light oil yield was realized by conversion of a conventional packed tower light-oil absorber to a new spray type unit that uses the principle of contacting gas and wash oil mist in an empty tower. After conversion one tower increased light oil production by 20.2% over two-tower operation with normal packing.

W. G. Bair

Maintenance Costs

Carnes, C. D. DECENTRALIZED MAINTENANCE LOWERS COSTS AT NATIONAL PETRO-CHEMICALS. *Petrol. Processing*, **11**, 44-47 (1956) December.

By decentralizing maintenance the National Petro-Chemicals' Tuscola, Illinois, plant was

able to cut maintenance costs from 10% to 7.2% of plant investment. H. L. Feldkirchner

Petro-chemicals

Dunnington, W. EAST OR WEST FOR PETROCHEMICALS? *Can. Chem. Processing*, **40**, 40-42 (1956) December.

The economic factors involved in building a petrochemical plant in Western Canada are discussed. H. L. Feldkirchner

Phthalic Anhydride

Riley, H. L. THE MANUFACTURE OF PHTHALIC ANHYDRIDE BY THE FLUIDIZED-CATALYST METHOD. *Chem. and Ind.* (British), No. 49, 1464-68 (1956) December 15.

Two improvements in equipment for a large, fluid-bed phthalic anhydride plant are given along with a study of the production level and methods of production of phthalic anhydride. H. L. Feldkirchner

10. CHEMICAL ENGINEERING

Enthalpy Charts

Younger, A. H. CHARTS HELP SOLVE HEAT BALANCES. *Chem. Eng.*, **63**, 209-211 (1956) November.

To find enthalpy of a gas mixture on a chart, only the mole percent of the constituent fractions and the temperature of the mixture have to be known. These charts save considerable calculating time and can be applied between 32 to 3000° F. While charts do not provide for the effect of pressure on the enthalpy, one can calculate an approximate correction. A problem illustrates the procedure and applied correction in detail. G. Kunst

Fluid Flow

Marris, A. W. ON FULLY DEVELOPED TURBULENT FLOW IN CURVED CHANNELS. *Can. J. Phys.*, **34**, 1134-46 (1956) November.

Formulae for the radial distribution of velocity and vorticity for the case of fully developed turbulent flow in the channel between concentric and infinitely long cylinders are developed on a similarity vorticity transfer theory. by postulating an Eulerian mixing length function dependent on both position and radius of curvature. The theoretical results obtained for the mean velocity distribution across the channel compare satisfactorily with existing experimental data when the curvature dependent parameters are given appropriate numerical values. R. T. Ellington

Fluidization

Halperin, J., and Stoughton, R. W. BATCH VERSUS CONTINUOUS PROCESSING FLUIDIZED NUCLEAR REACTORS. *Ind. Eng. Chem.*, **48**, 2115-22 (1956) December.

Kinetic equations are derived and solved for the concentrations of product and by-product transmutation elements in a nuclear reactor undergoing either batch or continuous chemical processing to remove these elements. The ratios of concentrations in the nuclear reactor of elements in the thorium breeder and uranium decay chain are calculated in therms of nuclear properties and operating variables and a comparison of nuclear element losses in batch and continuous processing is given. Advantages and disadvantages of either processing method are cited. C. G. von Fredersdorff

Pinchbeck, P. H., and Popper, F. CRITICAL AND TERMINAL VELOCITIES IN FLUIDIZATION. *Chem. Eng. Science* (British), **6**, 57-64 (1956) November.

Experimental data on initial and terminal fluidization velocities expressed in terms of Reynold's numbers are compared with theoretical equations for the Stokes law region and for regions outside the range covered by Stokes law. Satisfactory agreement is shown except in the case of small fluidization numbers, i.e., very large particles. In a generalized plot of the ratio of terminal to initial fluidization Reynold's numbers against the fluidization parameter it is shown that for very small particles in viscous flow both initial and terminal Reynold's numbers depend on the cube of the particle diameter. As the flow changes from viscous to turbulent, the terminal Reynolds number depends on progressively smaller powers of the particle diameter, and when fully turbulent flow exists this dependency is to the 1.5 power of the particle diameter. As the particle diameter is further increased, a point is reached

where the initial fluidization condition changes from viscous to turbulent flow and the initial Reynolds number then becomes dependent on the 1.5 power of the particle diameter. This explains the five types of regions encountered in fluidization and the changes in slope in each region of the generalized plot.

C. G. von Fredersdorff

Heat Transfer

Greyson, M., Mazie, G. P., Myers, J. W., Corey, R. C., and Graf, E. G. EVALUATION OF FACTORS AFFECTING HEAT TRANSFER IN FURNACES. *Amer. Soc. Mech. Eng. Trans.*, **78**, 1741-46 (1956) November.

The problem of correlating the heat-absorption efficiencies of coal-burning equipment has been studied for many years with little more than a modicum of success. It has been consistently pointed out that one of the major problems of correlating data such as these has been the lack of precise furnace data. This paper describes the attempt at using statistics to correlate more reliable furnace data by means of the Broida, Hudson-Orrok, a modified Hudson-Orrok, Wohlenberg, and Hurvich correlations. Results suggest that information about flame temperatures, flame volumes, and emissivities and temperatures of flames and slag-ash-covered boiler-tube walls are necessary before precise correlations can be made. Authors' Abstract

Nitrogen Oxide Recovery

Ermenc, E. D. WISCONSIN PROCESS SYSTEM FOR RECOVERY OF DILUTE OXIDES OF NITROGEN. *Chem. Eng. Progress*, **52**, 488-92 (1956) November.

The Wisconsin process was proven technically as a means for producing nitric acid, and the recovery system operated in accordance with design, except for minor modifications made in the field. Since the recovery system is not quite economic for the production of a cheap chemical like HNO_3 in the United States, it may have eventual use for the production of N_2O_4 or recovery of dilute oxides of nitrogen for pollution prevention. There may still be areas in the world where the Wisconsin process, as it now stands, may be economic, particularly where ammonia is not available or is high priced. The recovery operation of the plant installed at the Sunflower Ordnance Works near Lawrence, Kansas, is described in the accompanying article. Author's Abstract

11. PROCESS EQUIPMENT AND INSTRUMENTATION

Boiler Control Systems

Holzbock, W. G. FREQUENCY RESPONSE METHODS. *Air Condg., Heatg. and Ventilg.*, **53**, 104-113 (1956) November.

This article on Frequency Response Methods follows one on Instrumentation and Control of Boilers in the August 1956 issue. Step function response was used in the previous article to analyze the behavior of process, in particular the behavior of boilers, heat exchangers and air conditioning systems. Methods for frequency response, which are more time consuming than those for step function response are described in detail by the author. (See also *Gas Abs.*, **12**, 238 (1956) December. Author's Abstract

Contact Trays

Hutchinson, M. H., and Baddour, R. F. RIPPLE TRAYS—A NEW TOOL FOR VAPOR-LIQUID CONTACTING. *Chem. Eng. Progress*, **52**, 503-08 (1956) December.

In Ripple Trays the process industries have a new tool for vapor-liquid contacting, and one that is also potentially useful for contacting other two-phase systems in countercurrent flow. A major advantage is the economy made possible by high capacity and simple construction. The adaptability of the basic tray design is demonstrated by the wide range of applications in petroleum refining and chemical processing which have been covered by relatively few Ripple Tray types. Data presented in the accompanying article include those from studies with ethanol-water mixtures in a semiworks unit and from the performance of typical commercial operations. Authors' Abstract

CO_2 Handling

Clarke, W. C., and Brinkerhoff, R. CO_2 TANK CAR UNLOADS ITSELF. *Chem. Processing*, **19**, 17-19 (1956) December.

A large user of CO_2 installed an automatic process for using CO_2 direct from tank car

shipments of the liquid. Normal vapor pressure of the liquid is used for unloading.

W. G. Bair

Dust Removal

Yellott, J. I., and Buckley, F. D. (assigned to Bituminous Coal Research, Inc.). RECYCLING, PRESSURIZED VORTICAL WHIRL SEPARATOR CONCENTRATOR AND ASH STORAGE SYSTEM FOR POWDERED COAL-BURNING GAS TURBINE POWER PLANTS. U. S. 2,771,962 (1956) November 27.

Operating details are given for the ash separating system on the pulverized coal burning gas turbine developed at Bituminous Coal Research, Inc. The essential features are several banks of "Dunlab" or whirling separator tubes in parallel, which concentrate the ash into a small stream of motive fluid, followed by an ash separator tube which removes the bulk of the ash from the concentrated ash stream and returns clean motive fluid to the whirling separators.

C. G. von Fredersdorff

12. MATERIALS OF CONSTRUCTION

Carbon Structure

Bacon, G. E. A METHOD FOR DETERMINING THE DEGREE OF ORIENTATION OF GRAPHITE. *J. Appl. Chem.* (British), **6**, 477-81 (1956) November.

The preferential orientation of the carbon planes in blocks of graphite prepared by extrusion or pressing is described in terms of an orientation function and it is shown how this varies with the particle size of the starting materials. An "anisotropy factor" is defined as a useful index of the material. A discussion is given of the effect of orientation on the anisotropy of thermal and irradiation expansion of bulk graphite. The paper is based on a previously-classified report written in 1949.

Author's Abstract

Nelson, R. T. DESTRUCTIVE EFFECT OF ALKALI ON CARBON BRICK. *Ceramics*, **8**, 280-81 (1956) November.

The effect of a blast-furnace residue on carbon brick specimens was determined in a series of tests at temperatures of 1800°, 1600°, 1500° and 1400°F. in a reducing atmosphere. Major constituents of the blast furnace residue were alkali cyanides and alkali carbonates. The alkaline by-product of the blast furnaces was found to have a destructive effect on the carbon brick at temperatures as low as 1500°F. It is postulated the destructive action is due not only to chemical attack on the carbon brick but also to a physical attack resulting from the breakdown of the alkaline materials themselves.

E. J. Pyrcioch

Cathodic Protection

Hill, G. H. CATHODIC PROTECTION AT LAKE CHARLES. *Oil Gas J.*, **54**, 138-40, 145 (1956) October 15.

The design and operation of the cathodic protection systems used to protect lead-sheathed power and control cables, underground piping, and storage tank bottoms at the Lake Charles refinery of the Cities Service Refining Corp. are described. Tests run to determine cathodic protection requirements are described and a summary of the data obtained in these tests are presented. Construction details and the cathodic protection equipment specifications are also included.

G. G. Wilson

Coatings

Fair, W. F., Jr. PROPERTIES, SPECIFICATIONS, TESTS AND RECOMMENDATIONS FOR COAL TAR COATINGS. *Corrosion*, **12**, 579t-87t (1956) November.

Fundamental properties, long-term service characteristics, and specification writing and testing for various kinds of hot applied coal tar enamels are described. Emphasis is directed to the importance of long-term testing of coating types previously found to perform satisfactorily in service in various environments over long periods of time. A brief history of the use of hot applied coal tar coatings also is given. Technique of application and a list of commonly used types of pipe coating are given. Data are tabulated for eight plasticized and seven unplasticized enamels with respect to softening point, penetration, percent ash, specific gravity, high temperature sag and low temperature crack. Water absorption rates are plotted for several pipe line enamels. On other graphs the relationship between rate of shear and shearing stress is shown for a number of roofing pitches. Electrical resistivity, soil stress resistance, and oil spillage resistivity are discussed in connection with coal tar enamels. Author's Abstract

Hughes, R. C., Jr. NEW BARGE TAKES WEIGHT-COATING TO SEA. *Pipe Line Ind.*, **5**, 20-23 (1956) December.

A barge mounted plant to mix and apply a combination weight-and-protection coating to pipe is described. G. G. Wilson

Mixer, R. A., and Oechsle, S. J., Jr. PROTECTIVE LINING SYSTEMS. *Chem. Eng.*, **63**, 176-96 (1956) November.

A comprehensive survey of the use and application materials of construction from corrosion. This survey includes a discussion of the factors which should be considered in the selection of a lining material, of the types of linings currently available, and of factors to consider in the preparation of specifications for the application and inspection of linings. Illustrations presented include a bar graph of the comparative costs of various sizes of tanks unlined and lined with various materials, a sample specification for lining a vessel, and suggested construction techniques for vessels to be lined. G. G. Wilson

Quarles, W. R. NEW COATING FOR MARINE LINES. *Pipe Line News*, **28**, 21-23 (1956) December; *Petroleum Week*, **3**, 23 (1956) November 30.

Problems inherent to submarine pipeline construction principally those concerned with adding sufficient weight to pipe to anchor the line in place and applying a corrosion protection against marine organisms as well as physical deterioration have found a solution. Timcoat, developed by Gen. P. T. Timothy, is a tough pliable rubberized asphalt mastic internally and externally reinforced with glass fibers and filled with a barites aggregate. The most recent application was on a gas line of the Southern Natural Gas Co. The material is made from selected base asphalt refined from desalted crudes and contains synthetic rubber additive which amalgamates with the asphalt to form a water-proof coating. G. Kunst

Harwood, J. J. PROTECTING MOLYBDENUM AT HIGH TEMPERATURES. *Materials and Methods*, **44**, 84-89 (1956) December.

To date it has been impossible to utilize the high temperature strength of molybdenum because of the metal's poor oxidation resistance. However, new coating development show that: 1) electrodeposited chromium and nickel layers can protect molybdenum up to 2000°F.; 2) sprayed coatings may be applicable from 2000° to 2400°F.; 3) ceramic and molybdenum disilicide coatings hold promise for still higher temperatures. Author's Abstract

Reed, P. LONG PIPELINE WRAPPED WITH PLASTIC TAPE. *Oil Gas J.*, **54**, 70-72 (1956) November 26.

The application of a 12-mil polyethylene-tape coating to 122 miles of 22-in line for the American Louisiana Pipeline Co. is described. The discussion of the advantages, speed, quality, and costs of the application of this type of coating is included. G. G. Wilson

Hirschmann, W. B., WHAT DOES CORROSION REALLY COST? *Corrosion*, **12**, 68-70 (1956) December.

Determination of the cost of corrosion is not a simple, straightforward job. A part of the problem depends on what is meant by corrosion and what is meant by cost. This paper is a guide for isolating the cost of corrosion. By also taking into account the effects of taxes and the time value of money, a measure is obtained of the cost of corrosion which is credible, and what is meaningful in relation to other costs and the net earnings of an organization. Author's Abstract

Heat Insulation

GRAPH ELIMINATES TEDIOUS CALCULATIONS FOR COMMON INSULATING JOBS. *Ind. Heating*, **23**, 2431 (1956) November.

This article presents a chart for estimating heat loss for flat surfaces insulated and finished with mineral wool block insulation and insulating finishing cement. R. T. Ellington

Inhibitors

Jones, C. H., Jr. BATTLE AGAINST OCEAN-WATER CORROSION. *Oil Gas J.*, **54**, 76-79 (1956) November 26.

Severe corrosion problems were encountered when sea-water was used for water flooding an oil field. Exterior corrosion of the source-well casing necessitated the installation of cathodic

protection. The injection of several different types of inhibitive materials into the sea water was tried to curb corrosion of the injection well tubing and the results obtained are summarized. G. G. Wilson

Nickel Alloys

Schmid, D. SELECTING NICKEL ALLOY WIRE. *Materials and Methods*, **44**, 100-05 (1956) December.

Nickel, Monel and Inconel wire have good physical properties, good formability and good resistance to heat and corrosion. Here are detailed data and recommendations to help you select the best wire for a specific application.

Author's Abstract

Plastic Pipe

PLASTIC PIPE HAS OIL FIELD USE. *Oil Gas J.*, **54**, 117-19 (1956) October 15.

A summary of the experience of a company is given in the use of plastic pipe to handle oil field fluids in the Canton-Ritz field in Kansas.

G. G. Wilson

Refinery Steels

McFee, W. A. KNOW STAINLESS STEELS WHEN SELECTING FOR EQUIPMENT. *Ind. Eng. Chem.*, **48**, 1965-70 (1956) November.

A summary of the corrosion resistant properties of stainless steels. It includes a brief resume of the general properties and compositions of the four basic groups of stainless steel alloys and a discussion of the resistance of various types of stainless steels to atmospheric, general chemical, pitting, galvanic, crevice, and intergranular corrosion and to stress corrosion cracking. G. G. Wilson

13. NEW BOOKS

(C. A. Simms, Librarian)

Approved Equipment

Underwriters' Labs., Inc., GAS AND OIL EQUIPMENT LIST NOVEMBER, 1956. Chicago, Ill.: Underwriters' Labs., Inc., 263 pp., November, 1956.

This is the most recent list of summaries of general information cards and of Listing Card Reports now in effect on gas and oil equipment which has been examined and labelled as acceptable by the Underwriters' Labs., Inc., national service with reference to fire and accident hazards. Section I of 195 pages lists equipment and manufacturers' names covering chimneys, dispensers, fittings, compressed gas systems, heating appliances (gas and oil), heating accessories, hose, storage tanks, valves. Section II of 48 pages includes a large number and variety of products classed as to fire hazard only. O. P. Brysch

Pore Flooding

Rose, W., and Witherspoon, P. A. STUDIES OF WATERFLOOD PERFORMANCE. II. TRAPPING OIL IN A PORE DOUBLET. Illinois State Geological Survey, Circular 224 (1956).

This paper discusses the pore doublet, a parallel arrangement of a small- and large-diameter capillary tube, as a model of reservoir rock. The displacement of oil by water is analyzed for the pore-doublet system, and from the results we have developed revised notions about waterflood character and consequences. The conclusions reported are not all in accord with previous assertions of other authors, but we believe them to be consistent with expectations. Subjects specifically discussed include: 1) displacement efficiency as affected by viscosity ratio, pore texture, and capillary versus pressure-gradient driving forces; 2) explanations for the occurrence of subordinate phase production and the efficiency of inhibition waterflooding, and 3) concepts about fingering phenomena. The main conclusion, which is at variance with what has been previously asserted, is that oil tends to be trapped in the smaller (rather than the larger) tube of the pore doublet. Authors' Abstract

Scientist Shortage

THE GROWING SHORTAGE OF SCIENTISTS AND ENGINEERS. Proc. 6th Thomas Alva Edison Found. Institute (1955) November 21-22, 195 New York: New York University Press (1956).

This 132-page volume presents the proceedings of the Sixth Thomas A. Edison Foundation Institute. It includes papers and discussions on: Panel 1. Manpower policy and the efficiency of utilization of scientists and engineers; Panel 2. The problem: its dimensions and what is being done; Panel 3. The improvement of the quality of science teaching; Panel 4. What are the failures of science education in America?

R. T. Ellington

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American Gas Journal
American Institute of Chemical Engineers, Journal
American Petroleum Institute Quarterly
American Society for Testing Materials Bulletin
American Society of Mechanical Engineers. Transactions
Analytical Chemistry
Appliance Manufacturer
Association for Computing Machinery, Journal
Australian Journal of Applied Science
Australian Journal of Chemistry

Bituminous Coal Research Reports
Brennstoff-Chemie
British Coal Utilization Research Association Monthly Bulletin and Quarterly Gazette
Butane-Propane News

California Oil World
Canadian Chemical Processing
Canadian Gas Journal
Canadian Journal of Chemistry
Canadian Journal of Physics
Canadian Journal of Technology
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Drilling

Engineers' Digest
Erdöl und Kohle

Faraday Society. Transactions
Fuel
Fuel Efficiency
Fueloil and Oil Heat

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Gas Age
Gas and Oil Power
Gas Council (British) Publications
Gas Heat
Gas Journal
Gas Times
Gas und Wasserfach
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Heating, Piping and Air Conditioning

Independent Petroleum Association of America Monthly
Industrial and Engineering Chemistry
Industrial Finishing
Industrial Gas (American)
Industrial Gas (British)
Industrial Heating
Institute of Fuel (British). Journal
Institute of Gas Technology Publications
Institute of Petroleum (British). Journal
Institution of Gas Engineers. Bulletins, Communications and Transactions
Instruments

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Journal des Usines a Gaz
Journal of Applied Chemistry
Journal of Applied Mechanics
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Journal of Metals
Journal of Organic Chemistry
Journal of Petroleum Technology
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LP-Gas
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Mathematical Aids
Mechanical Engineering
Metal Progress
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National Advisory Committee for Aeronautics, Reports
National Fire Protection Association Quarterly
National Gas Bulletin of Australia
National Petroleum News
Nuclear Science and Engineering
Nucleonics

Official Gazette of the U.S. Patent Office
Oil and Gas Journal

Petroleum
Petroleum Engineer
Petroleum Processing
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